Remarks

Claims 1, 7, 20, 22-23, 25, 40, 43-47, 49-50, 62-63, 66-67, and 69 are amended. Claims 6, 24, 65 and 68 are canceled. Claims 32-35 were previously canceled. Claims 1-5, 7-23, 25-31, 36-64, 66-67 and 69-70 are pending.

Reconsideration and withdrawal of the rejections of the claims, in view of the amendments and remarks presented herein, is respectfully requested.

The 35 U.S.C. § 112(1) Rejection of the Claims

The Examiner rejected claims 25-39 and 50-70 under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. In particular, the Examiner alleges that the claims contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. This rejection is respectfully traversed.

The Examiner rejected claim 25, and the claims dependent thereon, on the basis that the recitation of "the cross-linking agent being deposited on the surfaces surrounding the internal pores of a preformed sol-gel material" finds insufficient support in the disclosure as originally filed. With regards to claims 66, 67, 69, and 70, the Examiner rejected those claims on the basis that the recitation of "act as template for the cross-linking agent" finds insufficient support in the disclosure as originally filed.

Applicant respectfully points out that on page 5, lines 12-23, of the instant specification, it is disclosed that, for example, silica aerogels consist of voids of about 50 nanometers in diameter, termed mesopores, and secondary particles characterized as a "pearl necklace" network that form the structure of the aerogel. The pearls are connected by "necks" which, if strengthened, would result in a stronger aerogel. To accomplish this, it is disclosed that the contour surface is used as a template for the deposition and growth of the interparticle cross-linker (lines 21-23). On page 5 lines 24-30, it is also disclosed that, for example, silica is surface-terminated with silanol groups, and that it is these silanol groups that react with cross-linkers. When the cross-linkers are isocyanates, the reaction with the silanol surface groups of the silica serve to form urethane bonds. These silanol chemical functionalities form the surfaces

that serve as the template and are the sites of reaction of the cross-linker. To cross-link the secondary particles, the cross-linker must be deposited on, and react with, for example, the surface of the silica particles, which are disclosed above to form the network enclosing the mesopores. Thus, Applicant respectfully submits that the cross-linking agent is clearly disclosed to be deposited on surfaces surrounding the internal pores of a preformed sol-gel material, as is claimed in claim 25, and the surfaces and their chemical functionalities serve as a template for reaction with the cross-linking agent, as is recited in claims 66, 67, 69 and 70.

Claim 39 was rejected on the basis that the recitation that "the cross-linked sol-gel material [of claim 25 is]...stronger or more robust than non-cross-linked sol-gel material" finds insufficient support in the disclosure as originally filed. Applicant respectfully points out that on page 5, lines 28-30, of the instant specification, it is disclosed that cross-linked aerogels have superior properties, with respect to non-cross-linked aerogels, that allow them to be used in a large variety of applications for which non-cross-linked aerogels are unsuitable. Furthermore, on page 11, lines 22-23, it is stated that urethane bonds of this type are thought to be useful for increasing the strength and resistance to breakage of cross-linked aerogels.

Additionally, on page 5 of the instant specification, it is disclosed that "in one example, the invention provides silica aerogel monoliths wherein the strength has been improved by a factor of over 100 through cross-linking the nanoparticle building blocks of preformed silica hydrogels with a cross-linking agent, such as poly(hexamethylene diisocyanate)." It is also disclosed that such cross-linked aerogels are termed composite aerogels. On page 14, line 1, it is further disclosed that composite monoliths are less hygroscopic and more robust than pure silica.

Furthermore, Table II (and the associated discussion on page 15, lines 3-26, of the instant specification) provides experimental evidence that the cross-linked sol-gel material is stronger or more robust than a non-cross-linked sol-gel material. Table II provides, for example, data correlating the load at rupture of a given sample with the amount of cross-linking reagent (a diisocyanate = di-ISO, see page 13, line 2). This data demonstrate that a native silica aerogel is less strong or robust than a cross-linked aerogel. When the w/w % of di-ISO is 0, the load at rupture is shown as 0.12 kg, whereas with 4% di-ISO the load at rupture increases to 1.75 kg, with 16% to 9.65 kg and with 42% to 14.7 kg, over 100 times greater.

Claim 50 was rejected on the basis that the recitation of a method comprising washing cross-linked sol-gel material with a solvent to exchange the pore-filling solvent with a new solvent is unsupported in the disclosure as originally filed. Applicant respectfully points out that on page 8, lines 19-21, of the instant specification, it is disclosed that when an silica network is formed in water, it must be dried to form an aerogel and that "this is simply accomplished by soaking the sol-gel like material in a solvent, such as alcohol, several times until the water is removed." Also on page 8, lines 29-31, it is disclosed that where the gel contains ethanol, it can be dried by "prior solvent exchange with CO_2...."

Additionally, on page 9, lines 2-12, a detailed description of how the ethanol / carbon dioxide solvent exchange is carried out is disclosed. Specific examples of solvent exchange are given in Example 1 (methanol => propylene carbonate => propylene carbonate/acetone => acetone); Example 2 (methanol => acetone => carbon dioxide); and Example 3 (methanol => pentane).

Claims 65 and 68 are canceled herein, rendering these rejections moot.

Thus, Applicant respectfully submits that pending claims are fully supported by the specification as originally filed and are in conformance with 35 U.S.C. § 112(1). Applicant respectfully requests that the Examiner withdraw the 35 U.S.C. § 112, first paragraph, rejection of the claims.

The 35 U.S.C. § 102(b) Rejection of the Claims

The Examiner rejected claims 1, 4-17, 20-31, 36, and 39-70 under 35 U.S.C. § 102(b) for anticipation by Kawakami et al. (U.S. Patent No. 6,364,953). This rejection is respectfully traversed.

Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration. *In re Dillon* 919 F.2d 688, 16 USPQ 2d 1897, 1908 (Fed. Cir. 1990) (*en banc*), cert. denied, 500 U.S. 904 (1991). It is not enough, however, that the prior art reference discloses all the claimed elements in isolation. Rather, "[a]nticipation requires the presence in a single prior reference disclosure of each and every element of the claimed invention, arranged as in the claim." *Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984) (citing *Connell v. Sears,*

Roebuck & Co., 722 F.2d 1542, 220 USPQ 193 (Fed. Cir. 1983)) (emphasis added). "The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989); MPEP § 2131.

Applicants submit that Kawakami et al. do not disclose every element of the rejected claims arranged as in the claims as amended herein, and thus, a *prima facie* case of anticipation has not been properly made by the Examiner. Specifically, Kawakami et al. do not disclose treatment of a preformed sol-gel material with a cross-linker, nor do Kawakami et al. disclose a cross-linker comprising an organic compound.

Claim 1, as amended herein, recites a method to prepare a porous material comprising (a) contacting a preformed sol-gel material with a cross-linking agent comprising an organic compound to provide a cross-linked sol-gel material; and (b) drying the cross-linked sol-gel material to form the porous material.

Kawakami et al. disclose that the gelation promoter acts to accelerate hydrolysis of the metal alkoxide or to accelerate condensation of the silanetetraol molecules (see, for example, column 11, lines 31-34), and thus, the gelation promoter is disclosed (column 7, line 50 through column 8, line 8) to be involved in the reaction of the tetraalkoxysilane with water. The preferred promoters are disclosed to be ammonia and hydrochloric acid.

It appears that the Examiner may be erroneously equating the gelation promoter disclosed by Kawakami et al. with the cross-linking agent of the instant application. However, the gelation promoter disclosed by Kawakami et al. is not equivalent to the cross-linking agent of the instant application. The gelation promoter (or retarder) of Kawakami et al. acts to accelerate (or impede) the formation of the initial sol-gel material (e.g., silica) from a silicate ester precursor, whereas the cross-linking agent of the instant application acts to react with the surfaces of the already-formed ("preformed") sol-gel. Thus, Kawakami et al. do not disclose contacting a preformed gel with a cross-linking agent.

Kawakami et al. also do not disclose the use of an organic compound as a cross-linking agent or even as a gelation promoter. In fact, Kawakami et al. do not disclose the use of any organic compound other than the use of an organic acid as a gelation retarder.

Thus, Kawakami et al. do not anticipate the claims as amended herein. Accordingly Applicant respectfully requests the Examiner to withdraw the rejections of the claims under 35 U.S.C. § 102((b).

The 35 U.S.C. § 103(a) Rejection of the Claims

The Examiner rejected claims 2-3, 18-19 and 37-38 under 35 U.S.C. § 103(a) as being unpatentable over Kawakami et al. (U.S. Patent No. 6,364,953) as applied to claims 1, 4-17, 20-36, and 39-64 above, and further in view of Barsotti et al. (U.S. Patent No. 6,428,898). This rejection is respectfully traversed.

Applicants respectfully submit that the Examiner has not established a *prima facie* case of obviousness. To establish a *prima facie* case of obviousness, three basic criteria must be met. First, all elements of the rejected claim must be found within the cited documents. *In re Wilson,* 424 F.2d 1382, 1385 (C.C.P.A. 1970). Second there must be a suggestion or motivation to combine the claim elements found within the references coupled with knowledge generally available in the art at the time of the invention. *C.R. Bard, Inc. v. M3 Sys., Inc.,* 157 F.3d 1340, 1352 (Fed. cir. 1998). Finally, the proposed combination must have a reasonable expectation of success at the time of the invention from the perspective of the person of ordinary skill in the art. *Amgen, Inc. v. Chugai Pharm. Co.,* 927 F.2d 1200, 1209 (Fed. cir. 1991).

Furthermore in M.P.E.P. § 2141.01, it is stated that "[i]n order to rely on a reference as a basis for rejection of an applicant's invention, the reference must either be in the field of applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the inventor was concerned." *In re Oetiker*, 977 F.2d 1443, 1446, 24 USPQ2d 1443, 1445 (Fed. Cir. 1992).

Applicant respectfully submits that the Barsotti et al. document is not within the field of Applicant's endeavor, and thus, may not properly be combined with Kawakami et al. to make a *prima facie* case of obviousness. The Barsotti et al. document relates to curable, high solids coating compositions for automobiles. It is classified in U.S. classes 428, 528, 427 and 106. While the present application has not yet received a classification, the Kawakami et al. document is classified in U.S. class 118. Applicant respectfully submits that there is no overlap. Furthermore, high solids, low solvent automobile coatings are not a field to which a person of

ordinary skill would look to solve problems involving stabilization and strengthening of sol-gels useful in the preparation of a dry porous material. Therefore Applicants respectfully submit that it is improper to use the Barsotti et al. document in a rejection under § 103.

Barsotti et al. disclose the reaction of a cross-linking component with a polymer having silicon/hydroxyl component (column 1, line 44 through column 2, line 6). Barsotti et al. define the silicon/hydroxyl component as being (I) a silicon/hydroxyl reactive oligomer having a linear or branched cycloaliphatic moiety and at least two functional groups with at least one of said groups being a silane or a silicate, the remaining groups being hydroxyl groups, (II) a silicon reactive oligomer having a linear or branched cycloaliphatic moiety and at least two functional groups being a silane, silicate or a combination thereof, and a hydroxy acrylic polymer, a hydroxy polyester, a silicon free reactive oligomer having a linear or branched cycloaliphatic moiety and at least two hydroxyl groups, or a combination thereof, or (III) a combination of (I) and (II).

It is clear that none of Barsotti's silicon-containing oligomers is used in the preparation of a porous material derived from a sol-gel (as recited the instant claims) -- rather, they are silicon-containing organic polymers for use in high-density applications such as automotive enamels. As such, they are not identical or even analogous to the sol-gel material, such as silica, that is cross-linked in the present invention. This is further clarified by Barsotti's disclosure at column 4, lines 4-9, that the presence of a linear or branched cycloaliphatic moiety in the silicon/hydroxyl reactive oligomer, silicon reactive oligomer and the silicon free reactive oligomer is critical. Further discussion in columns 4-7 of the Barsotti et al. document make it clear that the structures disclosed in the Barsotti et al. document are high-density organic polymers such as for use of automotive enamels, not a sol-gel material as is used in preparation of a porous material. As such, there would be no motivation for a person of ordinary skill to use the di-isocyanate cross-linking reagents of Barsotti et al. with the silica structure of Kawakami et al. Thus, there is no motivation or suggestion to combine the two cited documents. Nor is there any reasonable expectation of success in doing so.

Furthermore, as discussed above, Kawakami et al. do not disclose cross-linking of the surfaces of a preformed sol-gel material with a cross-linker. Barsotti et al. also do not disclose reaction of a preformed sol-gel material with a cross-linker. Therefore, the cited art does not

disclose or suggest all the elements of the pending claims. Thus, the claims are not obvious in view of Kawakami et al. further in view of Barsoitti et al.

Accordingly, none of the three criteria required to establish a *prima facie* case of obviousness exist. Withdrawal of the rejection of claims 2-3, 18-19 and 37-38 under 35 U.S.C. § 103(a) as obvious over Kawakami et al. (U.S. Patent No. 6,364,953) further in view of Barsotti et al. is respectfully requested.

Conclusion

Applicant respectfully submits that the claims are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney at (612) 373-6905 to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

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CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being filed using the USPTO's electronic filing system EFS-Web, and is addressed to: Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this 28 day of June, 2006.

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